

Proactive Computing

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Proactive Computing

Today: Computers are Interactive

- We are always waiting for them or vice-versa

Tomorrow: Computers will be Proactive

- They will anticipate our needs and act on our behalf

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Proactive Computing Enablers

Make it Personal

Empowering individuals and addressing their concerns over security and privacy

Closing the Loop

Bridging the gap between anticipating and acting on needs – predictably, and under human supervision

Dealing with Uncertainty

Using statistical modeling to deal with uncertainty inherent in the physical world

Planetary Scale Systems

Developing software that works across a wide range of diverse platforms and networks

Deep Networking

Driving computing deeper into our surroundings by networking billions of embedded nodes.

Getting Physical

Connecting computers directly to the physical world around them

Enabling Transition

We are on the verge of:

- a vast increase
- in the **spatial & temporal fidelity** at which
- we instrument & **analyze** the **physical** world.

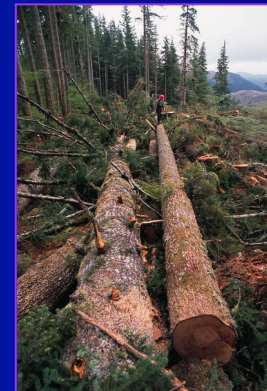
Proactive Computing Impacts Key Segments of Society & Economy



Health / Life
Sciences



Agriculture



Environment



Manufacturing



Distribution



Retail

**“Technology of the future – always
has been, always will be.”**

~ George H. Heilmeier

“Societal progress is an act of
collective will – always has been,
always will be.”

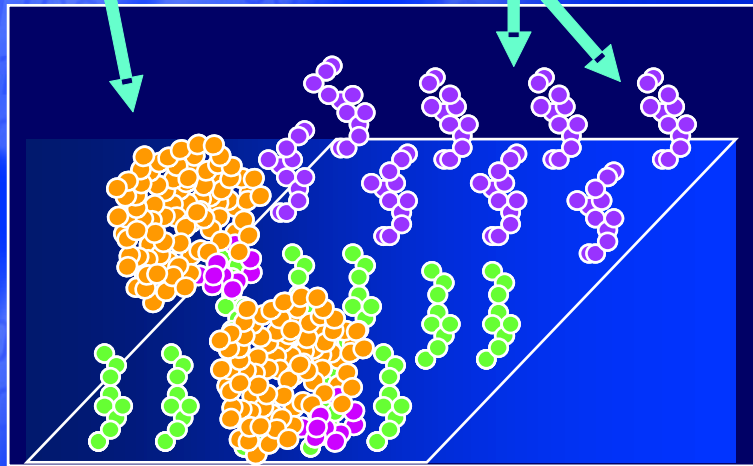
Proactive / Personal Health

- **People using information to take charge of their own & their family's health**
 - **Early disease detection**
 - **Elder care (Alzheimer's patients)**

Early Disease Detection

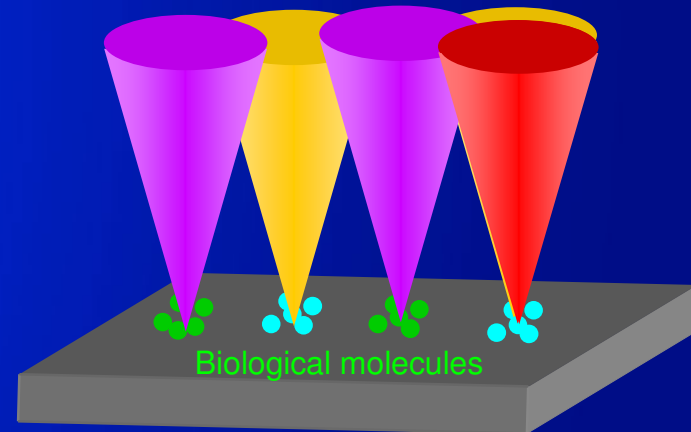
Proteins selectively
'stick' to peptides

Peptides



Peptide MicroArray

Optical excitation and signal



Precision Biology

Proactive Health Reinvent “Healthcare”



“Stan”
severe decline
ensuring safety



“Betty”
moderate decline
help w/ sequences

- Move beyond crisis-driven, reactive care to proactive & preventive care
- Shift focus of care from clinic to the home
- Prepare for boomers as very different kinds of elders & patients

Center for
Aging Services
Technologies



<http://www.agingtech.org/>



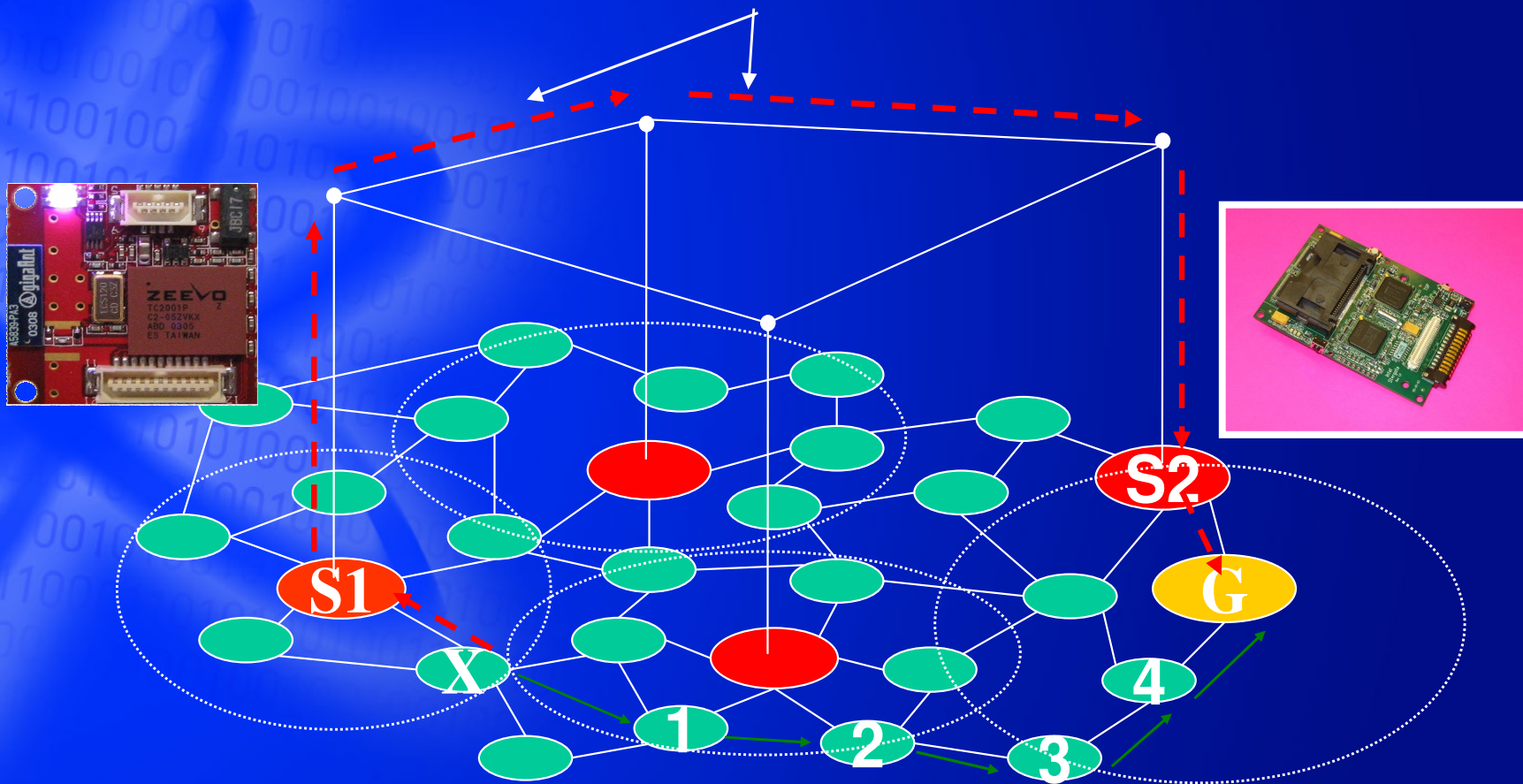
American Association
of Homes and Services
for the Aging

<http://www.aahsa.org/>

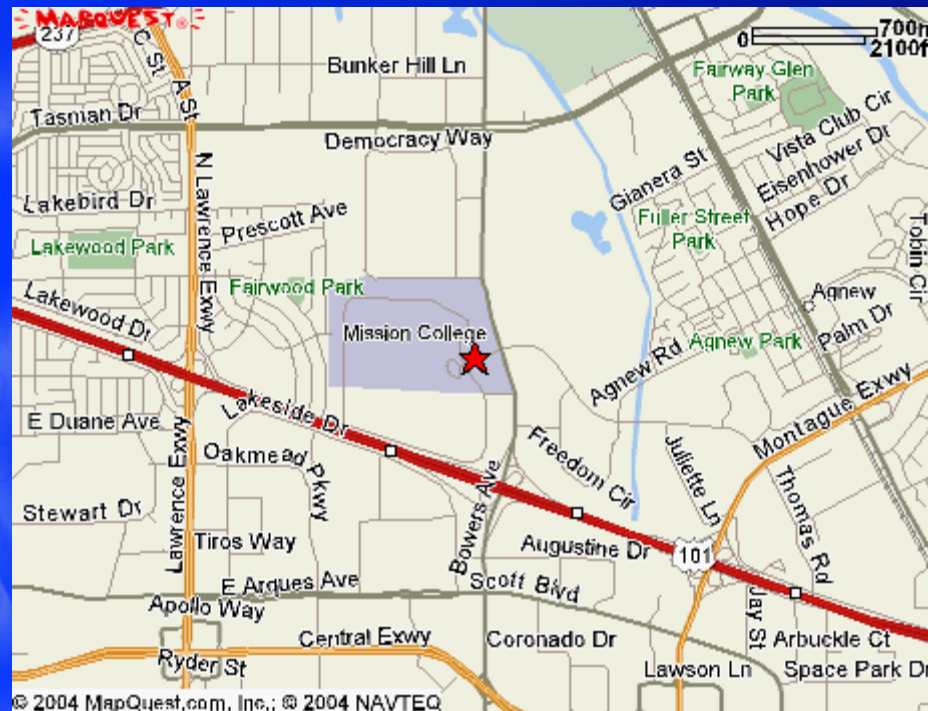
Environmental Awareness

- Seismic Monitoring
- Bio-Habitat Analysis
- Ecosystems, Biocomplexity
- Contaminant Transport
- Agriculture

Connecting the Physical & Virtual Worlds



Fine-grained Sensing

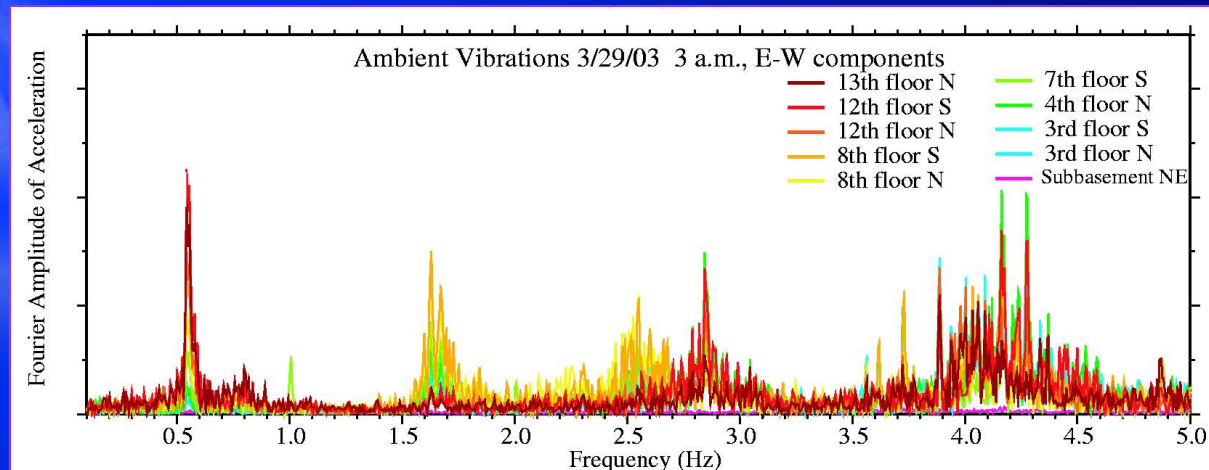




Structure Motion

Special characterization of structure

- Better detection of damage following earthquakes
- Track long term changes in structure and soil strength
- Recognize effects of environment (wind, rain, etc.)



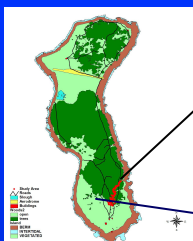
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Environmental Awareness

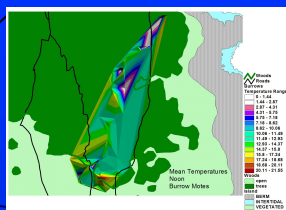
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Great Duck Island

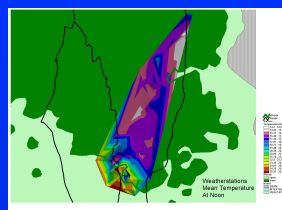
From Macro-to-Micro: Surface and Burrow Microclimates



Study site highlighted



Noontime Burrow Temps
(cool and uniform)



Noontime Surface Temps
(warmer and variable)

GIS data visualizations courtesy of J. Anderson / COA



Calibration

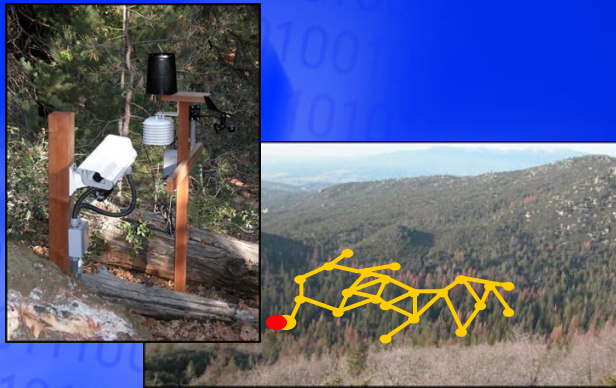
Great Duck Island (GDI) Project Team



Alan Mainwaring Intel
Robert Szewczyk UC Berkeley
Joe Polastre UC Berkeley
John Anderson College of the Atlantic

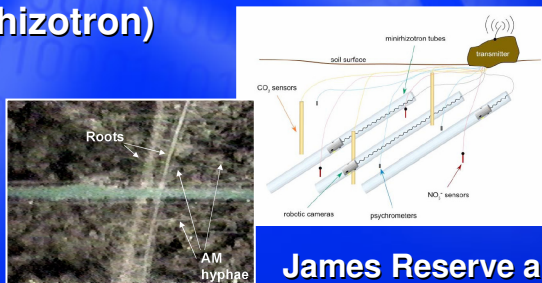


UC James Reserve Habitat Sensing

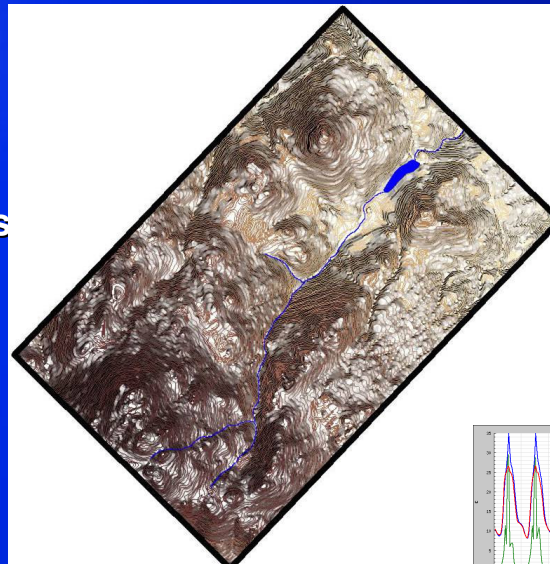


Dense micro-climate sensor networks
Extensible Sensor System (ESS)

Soil microclimate and
chemical sensors, root/fungi
imaging systems (mini-
rhizotron)

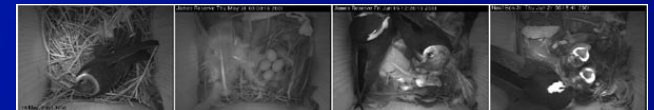
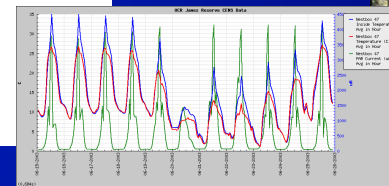


James Reserve and Hall Canyon Research Natural Area



NIMS: mobile ground and
canopy climate sensors, data
mules, and robotic samplers

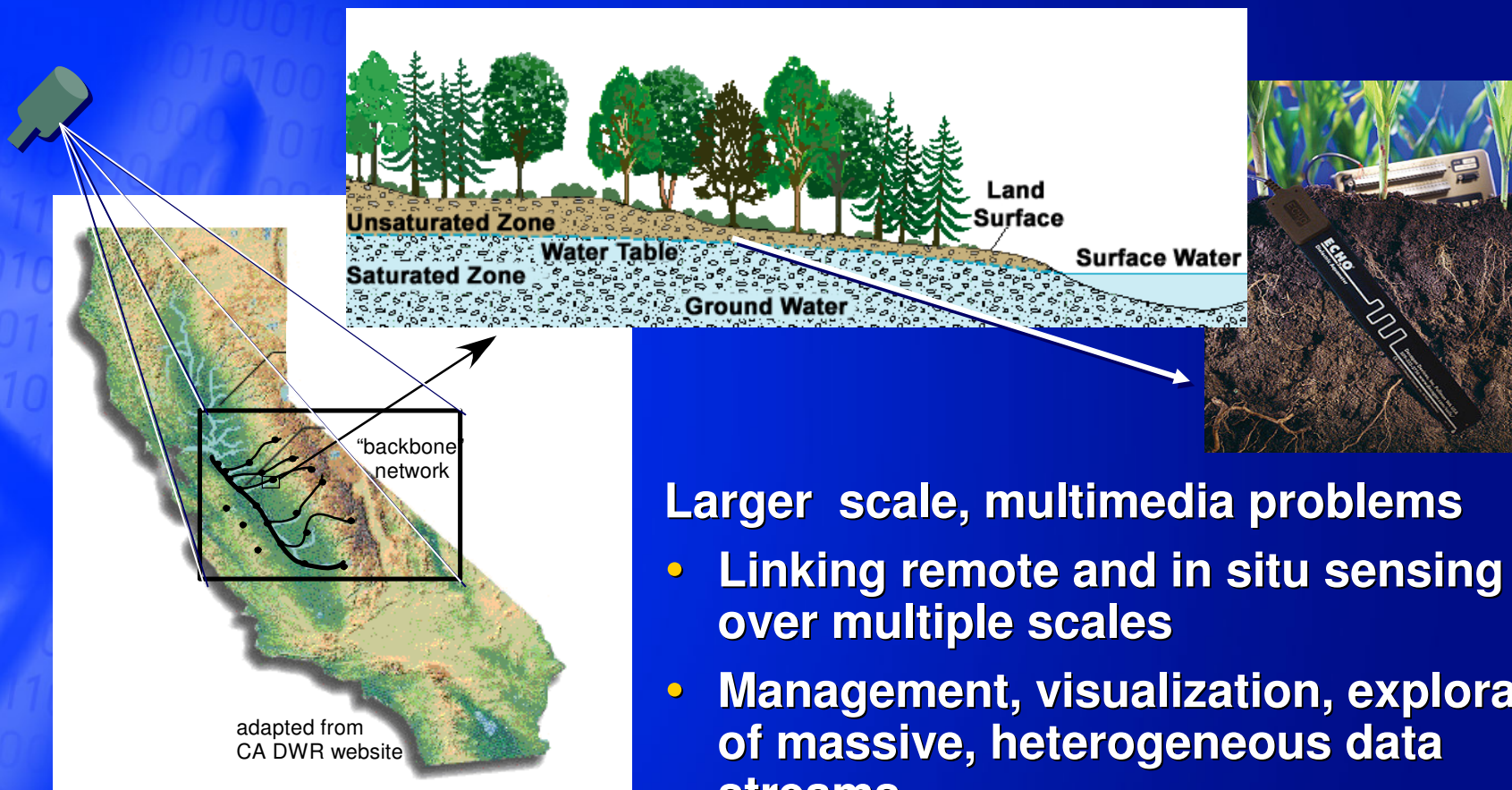
Cavity nest micro-climate, remote
observation, bioacoustic sensing



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Contaminant Transport



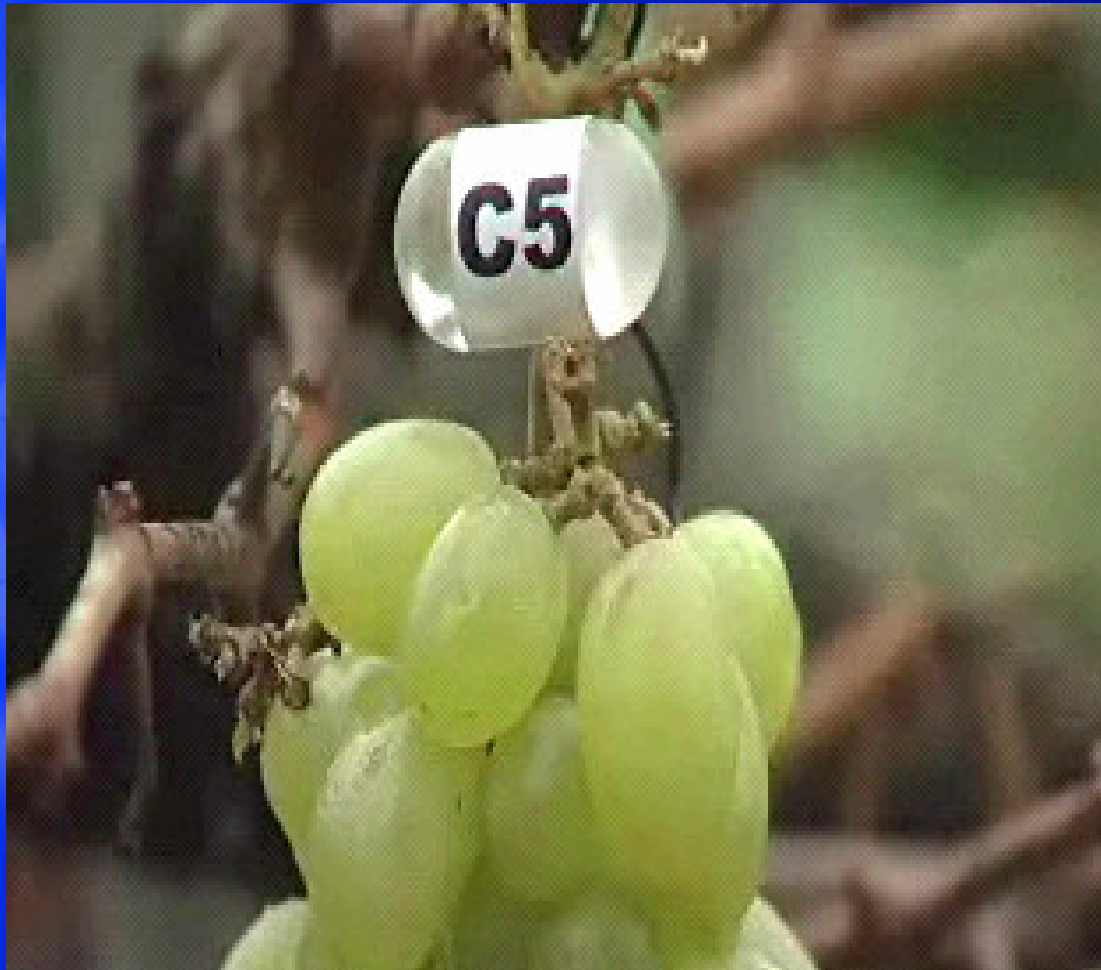
adapted from
CA DWR website

Larger scale, multimedia problems

- Linking remote and in situ sensing over multiple scales
- Management, visualization, exploration of massive, heterogeneous data streams
- NSF CLEANER Initiative

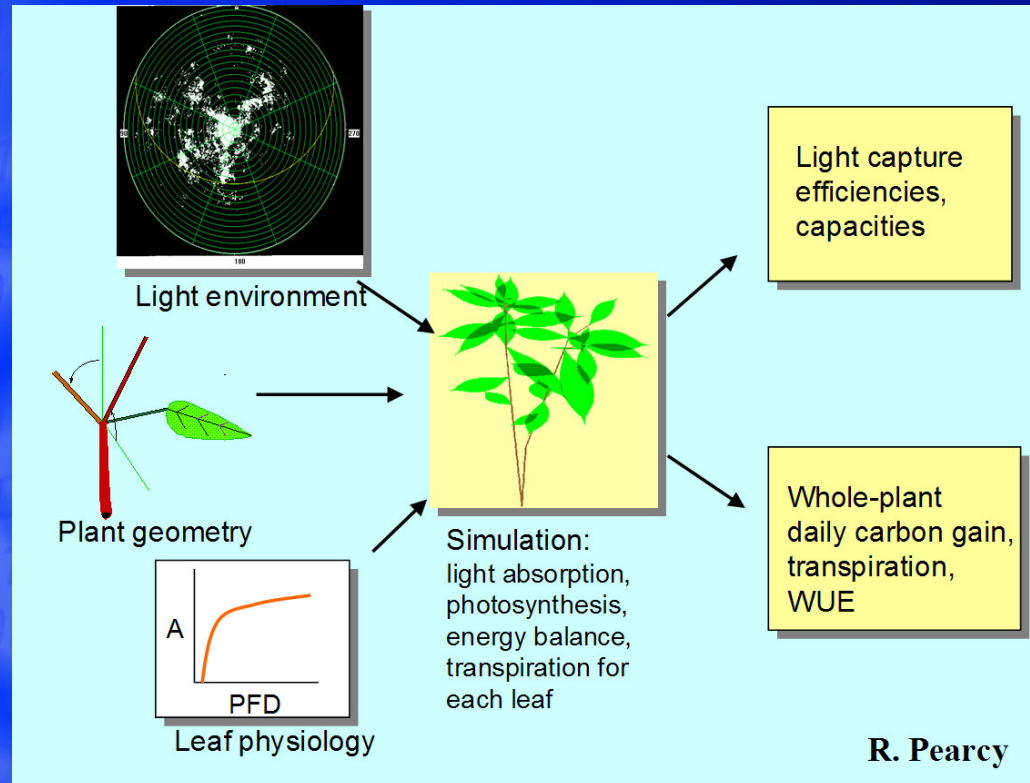
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Smart Agriculture





Ecophysiological Modeling Using Sensor Array Data



Spatially and temporally dense microclimate data will allow significant advancements in modeling plant ecophysiology

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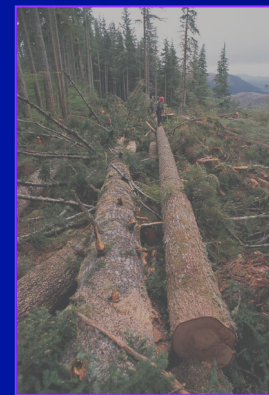
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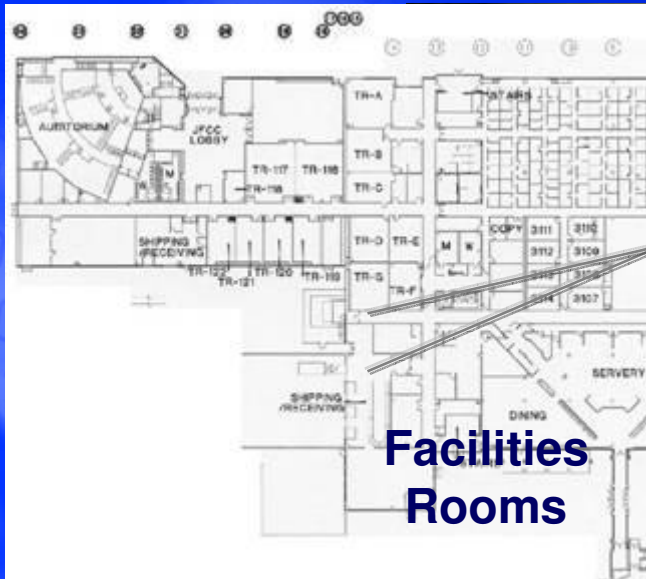


Distribution



Retail

Manufacturing: Condition-Based Maintenance



Intel **Research**

BP Industrial Monitoring



Chemicals Rail Car
Telematics



Lubricants Supply Chain



HSSE
Road
Safety



Remote Tank
Monitoring



Ship Engine Vibration
Monitoring

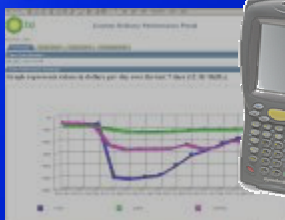


Industrial Site
Asset/People Tracking



LPG
Cylinder
Tracking

Contactless payment



Real Time Field
Processes

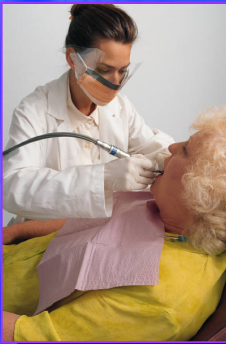


Pipeline
Monitoring



Retail Supply Chain & Delivery (video)

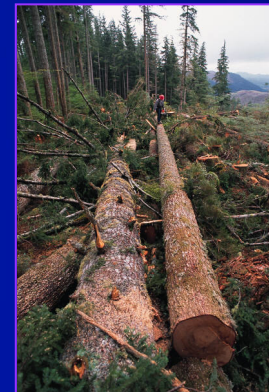
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Computers anticipating our needs:

- **Vast increase in spatial & temporal fidelity**
- **Wide range of societal & economic benefits**
- **Rapidly maturing technology**

“Societal progress is an act of **collective will** – always has been, always will be.”

To probe further

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